RESTING SPRING RANGE G-E-M
RESOURCES AREA
(GRA NO. NV-30)
TECHNICAL REPORT
(WSA NV 050-0460)

Contract YA-553-RFP2-1054

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Final Report

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EXECUTIVE SUMMARY

The Resting Spring Geology-Energy-Minerals (GEM) Resource Area (GRA) is about fifteen miles northwest of Pahrump, in Nye County, Nevada. There is one Wilderness Study Area (WSA): NV 050-0460. Its southwestern edge is the Nevada-California border.

Half of the rocks exposed in the GRA, and most of those in the WSA, are sediments about 500 million years old. In the remainder of the GRA, and in small areas at some edges of the WSA, the rocks are principally volcanic ash beds deposited about 25 million years ago that in at least some places have been altered to a zeolite mineral that has been mined close to the WSA. Very young gravels coverthe ash beds in many places.

No metal mining districts are present within the GRA. The closest is the Johnnie gold district about fifteen miles to the northeast. There are no metal prospects within the WSA, but there are some several miles to the south. There are no patented claims, but a great many unpatented claims have been located, most of them placer in the western and southeastern parts of the GRA, but also many lode claims in the northern, southern and eastern parts. None of the unpatented claims are in the WSA. There are a few scattered oil and gas leases in the valley areas, and no geothermal leases.

A short distance northwest of the WSA the nonmetallic mineral clinoptilite, one of several zeolite minerals, has been mined. Zeolites have an unusual crystal structure that makes them highly useful as catalysts and absorbents. Substantial quantities are used, although most current usage is of synthetic zeolites rather than natural ones such as occur here. Some specialists consider that in the future large quantities of natural zeolites will be used, because they are less expensive to produce but have properties similar to the synthetic ones. No other valuable mineral occurrences are known in the WSA or the GRA.

WSA NV 050-0460 is classified as having low favorability for metallic minerals, with a low level of confidence, on the basis of the presence of rock units that are known to be favorable for metallic ore deposits elsewhere in the region. Most of the WSA is classified as having no known favorability for uranium or thorium, with no confidence in the classification, but a small part of the north edge is classified as having low favorability for uranium with low confidence. All of the WSA is classified as having low favorability for nonmetallics, with low confidence in this classification. There is a high confidence level for no indicated favorability for oil and gas, and only a low favorability with a very low confidence level for geothermal resources. The WSA has no known potential for sodium and potassium.

No additional work is recommended for WSA NV 050-0460.

I. INTRODUCTION

The Resting Spring Range G-E-M Resources Area (GRA No. NV-30) contains approximately 67,000 acres (270 sq km) and includes the following Wilderness Study Area (WSA):

WSA Name	WSA Number
Resting Springs Range	NV 050-0460

The GRA is located in Nevada/California in the Bureau of Land Management's (BLM) Stateline/Esmeralda Resource Area, Las Vegas district. Figure 1 is an index map showing the location of the GRA. The area encompassed is near 36° 15' north latitude, 116° 15' west longitude and includes the following townships:

(Mt. Diablo Meridian)	(San Bernardino Meridian)
T 19 S, R 51,52 E	T 25 N, R 6, 7 E
T 20 S, R 51,52 E	T 24 N, R 6-8 E
T 21 S, R 52 E	T 23 N, R 7, 8 E

The areas of the WSA are on the following U. S. Geological Survey topogrpahic maps:

15-minute:

Ash Meadows

7.5-minute:

High Peak

The nearest town is Death Valley Junction, actually only a village, which is located about five miles west of the western GRA boundary, at the intersection of California State Route 127 and 190. Access to the area is via California State Route 127 to the west and Nevada State Route 16 to the east. Access within the area is via unimproved light duty and dirt roads throughout the GRA.

Figure 2 outlines the boundaries of the GRA and the WSA on a topographic base at a scale of 1:250,000.

Figure 3 is a geologic map of the GRA and vicinity, also at 1:250,000. At the end of the report, following the Land Classification Maps, is a geologic time scale showing the various geologic eras, periods and epochs by name as they are used in the text, with the corresponding age in years. This is so that the reader who is not familiar with geologic time subdivisions will have a comprehensive reference for the geochronology of events.

This GRA Report is one of fifty-five reports on the Geology-Energy-Minerals potential of Wilderness Study Areas in the Basin and Range province, prepared for the Bureau of Land Management by the Great Basin GEM Joint Venture.

The principals of the Venture are Arthur Baker III, G. Martin Booth III, and Dennis P. Bryan. The study is principally a literature search supplemented by information provided by claim owners, other individuals with knowledge of some areas, and both specific and general experience of the authors. Brief field verification work was conducted on approximately 25 percent of the WSAs covered by the study.

The WSA in this GRA was not field checked.

One original copy of background data specifically applicable to this GEM Resource Area Report has been provided to the BLM as the GRA File. In the GRA File are items such as letters from or notes on telephone conversations with claim owners in the GRA or the WSA, plots of areas of Land Classification for Mineral Resources on maps at larger scale than those that accompany this report if such were made, original compilations of mining claim distribution, any copies of journal articles or other documents that were acquired during the research, and other notes as are deemed applicable by the authors.

As a part of the contract that resulted in this report, a background document was also written: Geological Environments of Energy and Mineral Resources. A copy of this document is included in the GRA File to this GRA report. There are some geological environments that are known to be favorable for certain kinds of mineral deposits, while other environments are known to be much less favorable. In many instances conclusions as to the favorability of areas for the accumulation of mineral resources, drawn in these GRA Reports, have been influenced by the geology of the areas, regardless of whether occurrences of valuable minerals are known to be present. This document is provided to give the reader some understanding of at least the most important aspects of geological environments that were in the minds of the authors when they wrote these reports.

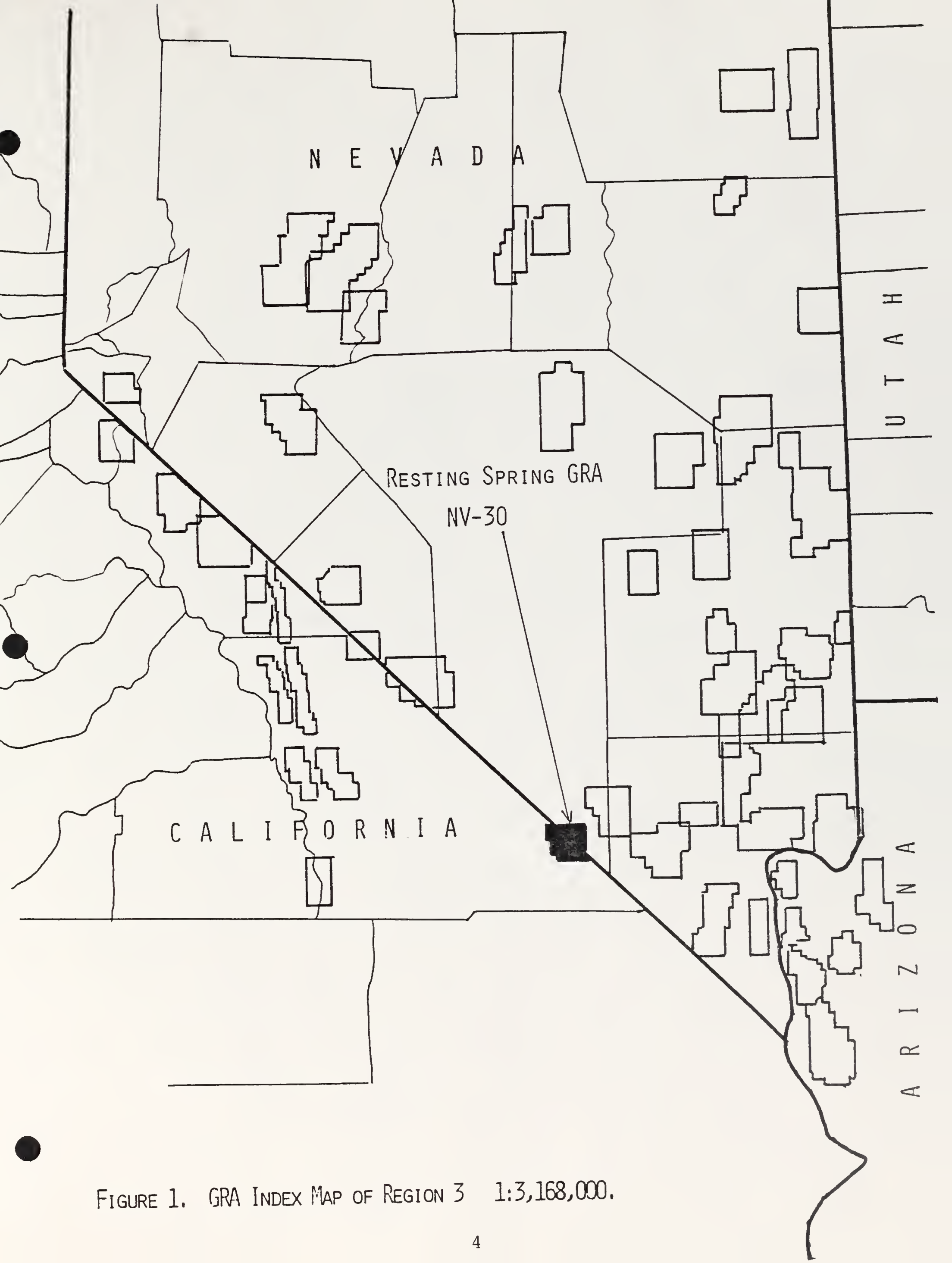
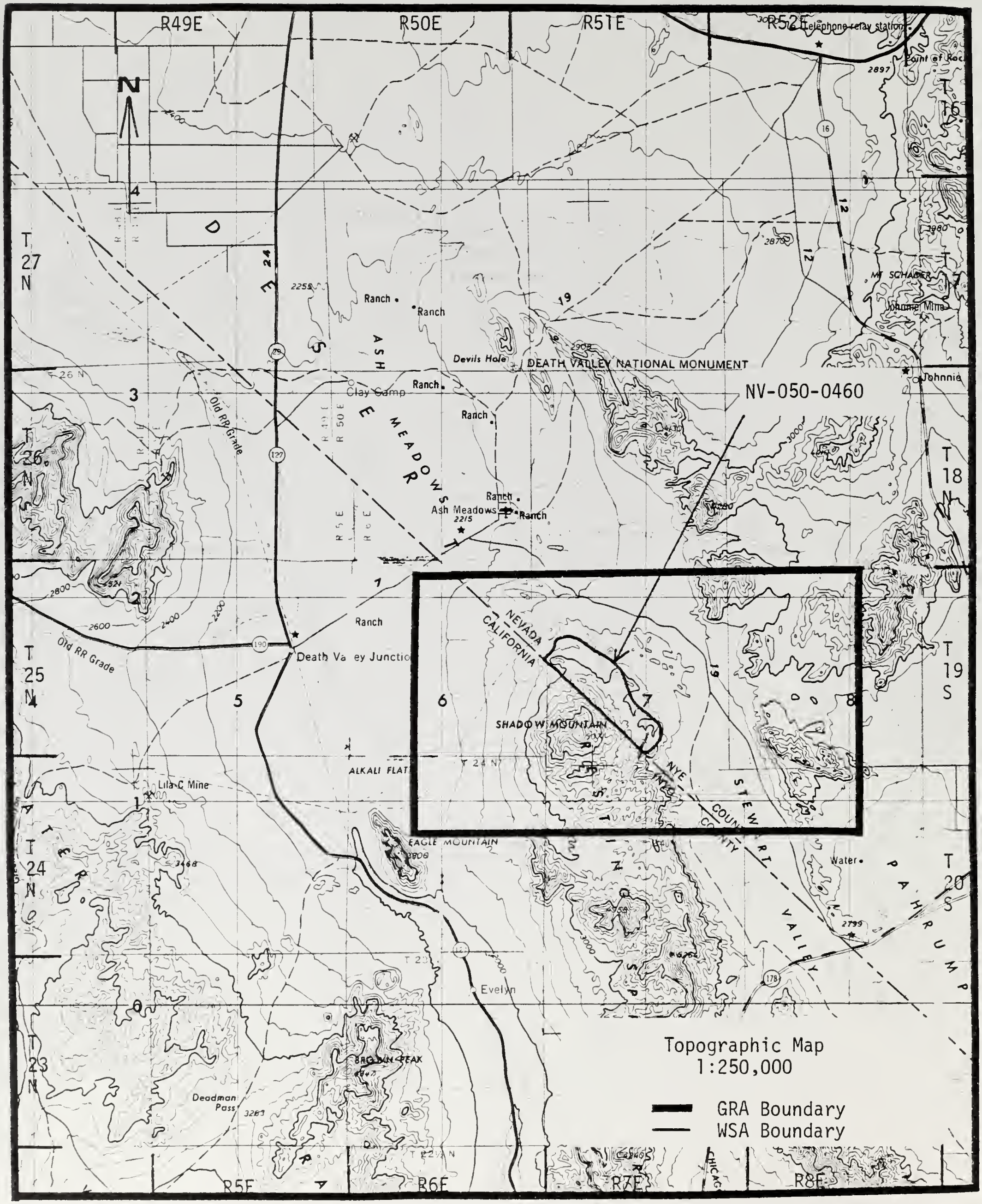


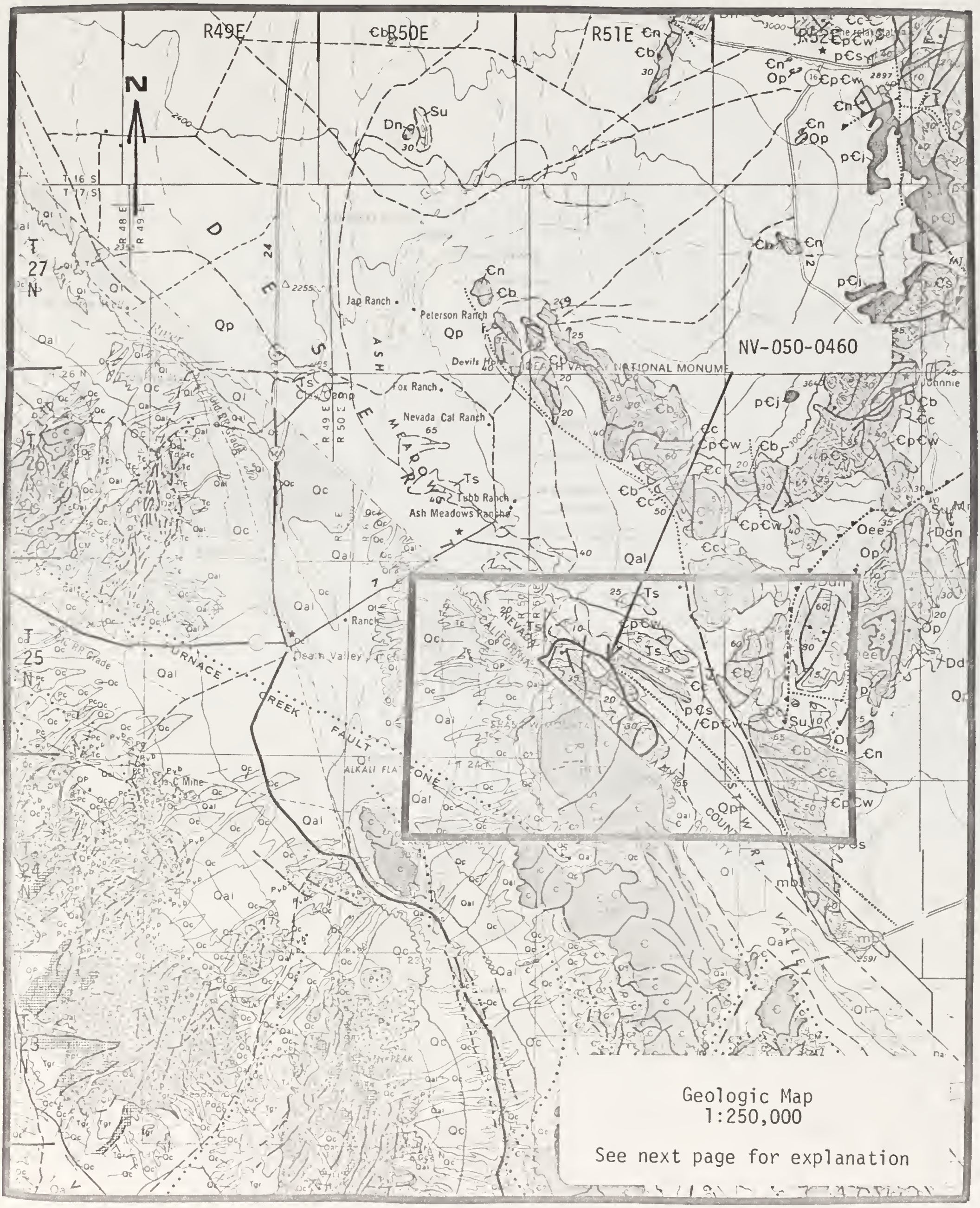
Figure 1. GRA Index Map of Region 3 1:3,168,000.



Death Valley Sheet

Resting Spring Range GRA NV-30

Figure 2



Geologic Map
1:250,000

See next page for explanation

Cornwall (1972):
Streitz and Stinson (1965)

Resting Spring Range GRA NV-30

Figure 3

EXPLANATION

Era	Period	Epoch	Symbol	SEDIMENTARY AND METASEDIMENTARY ROCKS	Symbol	IGNEOUS AND META-IGNEOUS ROCKS
CENOZOIC	QUATERNARY	Recent	Qs	Dune sand		
			Qal	Alluvium		
			Qsc	Stream channel deposits (GREAT VALLEY)	Qrv	Recent volcanic: Qrv^r —rhyolite; Qrv^a —andesite; Qrv^b —basalt; Qrv^p —pyroclastic rocks
			Qf	Fan deposits (GREAT VALLEY)		
			Qb	Basin deposits (GREAT VALLEY)		
			Qst	Salt deposits		
			Ql	Quaternary lake deposits		
			Qg	Glacial deposits		
		Pleistocene	Qt	Quaternary nonmarine terrace deposits		
			Qm	Pleistocene marine and marine terrace deposits	Qpv	Pleistocene volcanic: Qpv^r —rhyolite; Qpv^a—andesite; Qpv^b —basalt; Qpv^p —pyroclastic rocks
			Qc	Pleistocene nonmarine		
			QP	Plio-Pleistocene nonmarine	✳	Quaternary and/or Pliocene cinder cones
	TERTIARY	Pliocene	Pc	Undivided Pliocene nonmarine		
			Puc	Upper Pliocene nonmarine		
			Pu	Upper Pliocene marine	Pv	Pliocene volcanic: Pv^r –rhyolite; Pv^a–andesite; Pv^b –basalt; Pv^p –pyroclastic rocks
			Pmlc	Middle and/or lower Pliocene nonmarine		
			Pml	Middle and/or lower Pliocene marine		
		Miocene	Mc	Undivided Miocene nonmarine		
			Muc	Upper Miocene nonmarine		
			Mu	Upper Miocene marine	Mv	Miocene volcanic: Mv^r –rhyolite; Mv^a – andesite; Mv^b –basalt; Mv^p –pyroclastic rocks
			Mmc	Middle Miocene nonmarine		
			Mm	Middle Miocene marine		
			Ml	Lower Miocene marine		
		Oligocene	Φc	Oligocene nonmarine	Φv	Oligocene volcanic: Φv^r–rhyolite; Φv^a –andesite; Φv^b –basalt; Φv^p– pyroclastic rocks
			Φ	Oligocene marine		
		Eocene	Ec	Eocene nonmarine	Ev	Eocene volcanic: Ev^r –rhyolite; Ev^a –andesite; Ev^b –basalt; Ev^p –pyroclastic rocks
			E	Eocene marine		
		Paleocene	Epc	Paleocene nonmarine		
			Ep	Paleocene marine		

EXPLANATION CONT.

Era	Period	Symbol	Unit	Symbol	Unit	Symbol	Unit
	Pal.	Ep	Paleocene marine				
	Undivided	QT	Cenozoic nonmarine			QTv	Cenozoic volcanic: QTv^{r} -rhyolite; QTv^{a} —andesite; QTv^{b} —basalt; QTv^{p} —pyroclastic rocks
		Tc	Tertiary nonmarine			Tgr	Tertiary granitic rocks
		Tl	Tertiary lake deposits			Ti	Tertiary intrusive (hypabyssal) rocks: Ti^{r} —rhyolite; Ti^{a} —andesite; Ti^{b} —basalt
		Tm	Tertiary marine			Tv	Tertiary volcanic: Tv^{r} —rhyolite; Tv^{a} —andesite; Tv^{b} —basalt; Tv^{p} —pyroclastic rocks
MESOZOIC	CRETACEOUS	K	Undivided Cretaceous marine				
		Ku	Upper Cretaceous marine	KJf	Franciscan Formation	KJfv	Franciscan volcanic and metavolcanic rocks
		Kl	Lower Cretaceous marine			gr	Mesozoic granitic rocks: gr^{a} -granite and adamellite; gr^{g} -granodiorite; gr^{t} -tonalite and diorite
	JURASSIC	Jk	Knoxville Formation			bi	Mesozoic basic intrusive rocks
		Ju	Upper Jurassic marine			ub	Mesozoic ultrabasic intrusive rocks
		Jm'	Middle and/or Lower Jurassic marine			JTRv	Jura-Trias metavolcanic rocks
	TRIASSIC	TR	Triassic marine				
	UNDIVIDED	m ls	Pre-Cretaceous metamorphic rocks (ls = limestone or dolomite)			mv	Pre-Cretaceous metavolcanic rocks
		ms	Pre-Cretaceous metasedimentary rocks			gr-m	Pre-Cenozoic granitic and metamorphic rocks
PALEOZOIC		Pz ls	Paleozoic marine (ls = limestone or dolomite)			Pzv	Paleozoic metavolcanic rocks
	PERMIAN	P	Permian marine			Pv	Permian metavolcanic rocks
	CARBONIFEROUS	C	Undivided Carboniferous marine			Cv	Carboniferous metavolcanic rocks
		CP	Pennsylvanian marine				
		CM	Mississippian marine				
	DEVONIAN	D	Devonian marine			Dv	Devonian metavolcanic rocks
						Dv?	Devonian and pre-Devonian? metavolcanic rocks
	SILURIAN	S	Silurian marine				
		pSs	Pre-Silurian metasedimentary rocks	pS	Pre-Silurian metamorphic rocks	pSv	Pre-Silurian metavolcanic rocks
	ORDOVICIAN	O	Ordovician marine				
	CAMBRIAN	Є	Cambrian marine				
		Є?	Cambrian – Precambrian marine			pЄc	Precambrian igneous and metamorphic rock complex
PRECAMBRIAN		pЄ	Undivided Precambrian metamorphic rocks pЄg = gneiss, pЄs = schist			pЄgr	Undivided Precambrian granitic rocks
		lpЄ	Later Precambrian sedimentary and metamorphic rocks			pЄan	Precambrian anorthosite
		epЄ	Earlier Precambrian metamorphic rocks				

EXPLANATION

QUATERNARY

Pleistocene and Holocene

Qb
Basalt
Flows, plugs, and cinder cones

Qal
Alluvium
Fan and stream gravels flanking mountains and hills and grading outward into sands and silt in valley bottoms

Qp
Playa lake deposits

TERTIARY AND QUATERNARY

Pliocene and Pleistocene

QTal
Older alluvium
Boulders, cobbles, and finer material of varied lithology in older, partly dissected fans

TERTIARY

Pliocene

Tth
Thirsty Canyon Tuff
Comenditic and pantelleritic ash-flow and ash-fall tuff

Ttr
Trachyte
Flows and intrusive masses

Trb
Rhyolite of Black Mountain
Flows

Tb
Basalt
Flows and plugs

Tw
* Welded tuff
Ash flows, mostly rhyolitic, locally includes older ash flows

Tt
*Ash-fall tuff and nonwelded ash-flow tuff

Tl
* Quartz latite
Flows and intrusive masses

Miocene and Pliocene

Tp
Timber Mountain (Pliocene) and Paintbrush Tuffs and tuff of Crater Flat (Miocene)
Includes ash-fall tuffs and conformably overlying Paintbrush and Timber Mountain Tuffs. Consists of rhyolitic ash-flow and minor ash-fall tuffs

Miocene

Tbr
Belted Range Tuff
Comenditic ash-flow and ash-fall tuff

Ti
Indian Trail Formation
Includes rhyolite, rhyolitic ash-flow, and ash-fall tuff, locally includes older units around Yucca Flat

Tws
Wahmonie and Salyer Formations
Dacite, rhyodacite, and latite flows, breccias, tuffs, and tuffaceous sandstones, locally includes tuffaceous sediments underlying these formations

Ts
Tuffaceous sedimentary rocks

Tts
Tuff and tuffaceous sedimentary rocks

Tf
Fraction Tuff
Rhyolite and quartz latite ash flows

Tg
Coarse-grained rhyolite porphyry intrusions

Ta
Andesite
Flows and intrusive masses

Tdv
Dacite vitrophyre
Dacitic ash flows

Tl
* Quartz latite
Flows and intrusions

Tr
Rhyolite
Flows and intrusive masses

Td
Dacite and rhyodacite
Rocks of intermediate composition, includes flows and intrusive masses of dacite, less extensive rhyodacite, and minor andesite and quartz latite

Twb
Tuff of White Blotch Spring
Rhyolitic ash flows

Tma
Milltown Andesite
Andesite flows and intrusive masses

Twa
Tuffs of Antelope Springs
Welded ash-flow tuff

Oligocene or Miocene

Tm
Tuff of Monotony Valley
Rhyodacite and quartz latitic ash-flow and ash-fall tuff

Tt
*Ash-fall tuff and nonwelded ash-flow tuff

Tw
* Welded tuff
Ash flows, mostly rhyolitic

Oligocene

Ttc
Titus Canyon Formation
Conglomerate with interbedded sandstone, siltstone, limestone, and tuff

MESOZOIC OR TERTIARY

mb
Megabreccia
Landslide blocks of monolithologic [illegible] breccia from Bonanza King Formation

MESOZOIC OR TERTIARY

mb

Megabreccia

Landslide blocks of [illegible] dolomite [illegible] Bonanza King Formation

MESOZOIC

Mzm

Intrusive masses of quartz monzonite and granodiorite

PENNSYLVANIAN

IPt

Tippipah Limestone

MISSISSIPPIAN

Mc

[illegible]

DEVONIAN AND MISSISSIPPIAN

MDe

Eleana Formation

[illegible] conglomerate, quartzite, shale [illegible] limestone

DEVONIAN

Middle and Upper Devonian

Dd

Devils Gate Limestone

Limestone, minor dolomite, and lenticular quartzite

Lower and Middle Devonian

Dn

Nevada Formation

Dolomite, minor mudstone

Ddn

Devils Gate Limestone and Nevada Formation

SILURIAN AND DEVONIAN

DSu

Dolomitic sedimentary rocks undivided

SILURIAN

Middle Silurian

Slm

Lone Mountain Dolomite

Srm

Roberts Mountains Formation

Platy dolomite and limestone

Su

Sedimentary rocks, undivided

Dolomite, minor limestone

Pzu

Paleozoic sedimentary rocks, undivided

ORDOVICIAN

Middle and Upper Ordovician

Oe

Ely Springs Dolomite (Middle and Upper Ordovician) and Eureka Quartzite (Middle Ordovician)

Lower and Middle Ordovician

Op

Pogonip Group

Limestone, shaly limestone, and minor dolomite

CAMBRIAN

Upper Cambrian

Cn

Nopah Formation

Dolomite, limestone, and minor shale

Middle and Upper Cambrian

Cb

Bonanza King Formation

Dolomite and limestone with alternating light- and dark-gray bed

Ce

Emigrant Formation

Claystone and limestone

Lower and Middle Cambrian

Cc

Carrara Formation

[illegible]

Cz

[illegible] Quartzite

Єc

Carrara Formation

[illegible]

Єz

Zabriskie Quartzite

ЄpЄw

Wood Canyon Formation

[illegible]

pЄs

Stirling Quartzite

Quartzite with interbedded [illegible] schist and minor marble

pЄj

Johnnie Formation

[illegible] shale, fine-grained quartzite, and minor marble

pЄu

Gneiss and schist, undivided

pЄr

Reed Dolomite

pЄw

Wyman Formation

Siltstone with limestone interbeds

CAMBRIAN

PRECAMBRIAN

Contact

Dashed where approximately located

High-angle fault, showing dip and relative movement

Dashed where approximate, dotted where concealed Ball is on downdropped side

Low-angle thrust fault showing dip

Dotted where concealed Sawteeth on upper plate

Strike and dip of beds and compaction foliation in welded tuffs

Vertical Overturned

Strike and dip of beds

Horizontal beds

Caldera

Mine shaft

Exploration shaft or adit

*Note: Repetition of this map unit within the column indicates known age differences

II. GEOLOGY

The Resting Spring GRA is in the Basin and Range province in southeastern Nye County, Nevada and eastern Inyo County, California. WSA 050-0460 is on the northeastern flank of Shadow Mountain which forms the northern tip of the Resting Springs Range.

The northern Resting Spring Range is largely composed of Precambrian and Cambrian marine sediments which have been displaced by normal faults usually less than one mile in length. The Furnace Creek fault zone, over 18 miles long, terminates southward at the southwestern flank of Shadow Mountain. Another major normal fault bounds the southwestern flank of the foothills in the eastern portion of the GRA.

1. PHYSIOGRAPHY

The Resting Spring GRA lies within the Basin and Range province in southeastern Nye County and eastern Inyo County. WSA 050-0460 is located on the northeastern flank of Shadow Mountain at the northern tip of the north-south-trending Resting Spring Range. The southwest border of the WSA is the California-Nevada State border. A northwest-trending belt of hills comprised of Cambrian sediments is located on the northeastern portion of the GRA. A prominent northwest-trending normal fault follows the western boundary of these hills.

The northern Resting Spring Range is composed of several thousand feet of Precambrian and Cambrian sediments.

The topography of the Resting Spring Range is fairly rugged with elevations along the crest of the range in this area averaging about 4,500 feet. Seasonal streams discharge into Amargosa Valley, Ash Meadows and Stewart Valley, which are at elevations ranging from 2,000 feet to 2,500 feet.

2. ROCK UNITS

The oldest rock unit in the Resting Spring GRA is the Precambrian Stirling Quartzite, which is locally referred to as the Shadow Mountain Quartzite (Denny and Drewes, 1965). Conformably overlying the Stirling Quartzite is the Lower Cambrian Wood Canyon Formation which consists of quartzitic sandstone, siltstone, micaceous shale and marble. The Carrara Formation, an interbedded sequence of limestone, siltstone and micaceous shale was deposited next. Conformably overlying the Carrara Formation is the Bonanza King Formation which consists of dolomite and limestone with alternating light and dark gray beds. Deposited next was the Upper Cambrian Nopah Formation which includes dolomite, limestone, and minor shale (Cornwall, 1972).

The Pogonip Group, a series of limestone, shaly limestone and minor dolomite units, was deposited during the Lower Ordovician. The Ely Springs Dolomite and Eureka Quartzite were deposited next in Middle and Upper Ordovician time. These formations are overlain by an undivided sequence of Silurian dolomite and minor limestone, and are found in the hills northeast of Shadow Mountain.

The Devonian Devils Gate Limestone and the Nevada Formation, which consists of dolomite, quartzite, and minor limestone have been grouped together in this area by Cornwall (1972).

Miocene tuffaceous lake beds which include conglomerate, sandstone, siltstone, ash-fall tuffs and ash-flow tuffs crop out north of the Resting Spring Range. These beds contain zeolites, the only known mineral resource of the area.

Pliocene(?)-Pleistocene(?) fanglomerates unconformably overlie the older formations in the northern Resting Spring Range. This formation also includes sandstone beds and thin beds of pumice.

Quaternary alluvial fan deposits cover much of the western slopes of the northern Resting Spring Range.

No igneous rocks, either intrusive or extrusive, are known in the GRA or nearby, except for the tuffaceous units in the Miocene and Pliocene sediments.

Of the thick sequence of Paleozoic sediments, only the lowermost part -- the Stirling Quartzite, Wood Canyon Formation, Zabriskie Quartzite, Carrara Formation and Bonanza King Formation, crop out in the very small area of WSA NV 050-0460.

3. STRUCTURAL GEOLOGY AND TECTONICS

Shadow Mountain is a block of east-dipping Paleozoic rocks that is probably bounded by border faults covered by thick sequences of Cenozoic fanglomerates.

The Furnace Creek fault zone, a major northwest-trending Basin and Range normal fault with significant right oblique movement, terminates southward along the southwestern border of Shadow Mountain (Streitz and Stinson, 1974). West of the peak a small mass of limestone and dolomite has apparently been down-dropped along a northeast-trending fault.

Several north-striking high-angle normal faults at the north end of the range have displaced Tertiary clastics. A few hundred feet south of Shadow Mountain, a small south-dipping wedge of fanglomerate has been down dropped relative to the Paleozoic rocks along an east-trending high-angle fault.

At the north end of the range, the Tertiary rocks form a broad anticline whose axis lies close to the broad northwest-trending wash entering the Ash Meadows quadrangle from the east (Denny and Drewes, 1965).

A normal fault more than 18 miles long bounds the southwest flank of the hills in the eastern portion of the study area. Smaller normal faults in these hills generally trend about east-west and terminate at the range front fault. Several thrust plates of Paleozoic sediments have been identified by Cornwall (1972) in this area.

4. PALEONTOLOGY

Tertiary sediments equivalent to the Panaca(?) Formation are known to contain paleontological resources in other areas of exposure, such as north of the Nevada Test Site (Orkild, personal comm.), but are not known to be fossiliferous within the GRA boundaries. Cambrian strata are not known to contain fossils within the GRA.

5. HISTORICAL GEOLOGY

Throughout the Paleozoic era marine miogeosynclinal sediments were deposited in the region.

Folding, thrusting, and strike-slip faulting caused by tectonic forces of the Sevier orogeny deformed the Paleozoic sediments in the region mainly during the Cretaceous. Volcano-tectonic activity during the Miocene resulted in the accumulation of tuffaceous sediments north of Shadow Mountain.

Subsequent to the volcanism, Basin and Range faulting during the mid-Tertiary formed much of the present-day topography. The broad anticlinal folding of the Tertiary sediments occurred at this time.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

Cornwall (1972) shows no deposits or prospects in the Nevada part of the GRA. Norman and Stewart (1951) show no deposits or prospects in the California part of the GRA. The nearest known deposits or prospects are the Nopah silver-lead-zinc mine and the Baxter silver-lead prospect, both just south of the GRA (Norman and Stewart, 1951).

2. Known Prospects, Mineral Occurrences and Mineralized Areas

No metallic mineral prospects, mineral occurrences or mineralized areas are known in the GRA.

3. Mining Claims

There are no patented claims in the GRA.

There are a great many unpatented claims in the GRA, but none in WSA NV 050-0460. Those at the west edge of the GRA are placer claims located for an unknown purpose. A short distance east of them, the cluster of claims on the Nevada side of the state line are lode claims located by Anaconda Minerals Co. for zeolites. These will be discussed in the section on Nonmetallic Minerals. The claims in the Resting Spring range at the south edge of the GRA, and those in the hills east of the range, are lode claims also.

4. Mineral Deposit Types

Although no metallic mineral deposits or occurrences are known in WSA NV 050-0460, the geology is somewhat favorable for gold occurrences. Cornwall (1972) states that in several districts of southern Nye County gold is disseminated in dolomite beds of the Johnnie Formation or Stirling Quartzite, and the latter is mapped in the WSA (Cornwall, 1972). In the Johnnie district 15 miles northeast of the WSA, gold-bearing veins are in the Zabriskie Quartzite and underlying dolomite beds near the top of the Wood Canyon formation. Ivosevic (1976) notes that this horizon is a favorable stratigraphic site for ore deposition elsewhere in the Great Basin. The Wood Canyon Formation is mapped in the WSA (Cornwall, 1972).

The claim group in the hills east of the range plot about properly to cover an area in which both horizons are present (Cornwall, 1972). The claim group at the south edge of the GRA may be on the same horizons. The implication of these claim groups is that some company has found features interesting enough to prospect these horizons very close to the WSA.

The Nopah mine south of the GRA has produced five railroad carloads of lead-zinc-silver ore from replacement bodies in dolomitic limestone. The Baxter occurrences are in replacement bodies in dolomite, with no production stipulated (Norman and Stewart, 1951). The formations in which the occurrences lie are not known.

5. Mineral Economics

The major use of gold is for storing wealth. It is no longer used for coinage because of monetary problems, but many gold "coins" are struck each year for sale simply as known quantities of gold that the buyer can keep or dispose of relatively easily. The greatest other use of gold is in jewelry, another form of stored wealth. In recent years industrial applications have become increasingly important, especially as a conductor in electronic instrumentation. In the United States and some other countries gold is measured in troy ounces that weigh 31.1 grams -- twelve of which make one troy pound. Annual world production is about 40 million ounces per year, of which the United States produces somewhat more than one million ounces, less than one-fourth of its consumption, while the Republic of South Africa is by far the largest producer at more than 20 million ounces per year. World production is expected to increase through the 1980s. For many years the price was fixed by the United States at $35 per ounce, but after deregulation the price rose to a high of more than $800 per ounce and then dropped to the neighborhood of $400 per ounce. At the end of 1982 the price was $460.50 per ounce.

Vein-type occurrences of gold, such as those at the Johnnie district, are not of interest to most mining companies, though they may be profitable for small organizations. The possibility of disseminated gold mineralization, perhaps in large open pittable deposits, is of great interest to any mining company.

B. NONMETALLIC MINERAL RESOURCES

1. Known Mineral Deposits

Zeolites have been mined from a pit near the Ash Meadows Ranch a short distance north of the GRA, and from another pit farther south, in the northwest corner of the GRA (personal communication, Richard Knostman, Anaconda Minerals Co., November, 1982; see notes in GRA file).

2. Known Prospects, Mineral Occurrences and Mineralized Areas

If, as postulated below, the zeolites mined by Anaconda are in tuff units of Denny and Drewes' (1965) Tsc lakebeds, then these same tuff units extend beyond the area understood to be claimed by Anaconda, and specifically, into the north end of WSA 050-0460.

No other nonmetallic prospects, occurrences or mineralized areas are known.

3. Mining Claims, Leases and Material Sites

The third group of mining claims mentioned under Metallic Mineral Resources is the Anaconda group, located for zeolites north and west of WSA NV 050-0460.

No other claims located for zeolites are known. There are no mineral leases in the GRA. No material sites are known in the WSA.

4. Mineral Deposit Types

Zeolite minerals (there are several types) in occurrences such as those in the GRA are formed by the alteration of tuff beds deposited in alkaline lakes. Some tuffs are made up of tiny shards of essentially pure glass formed by quick cooling of molten lava when it is blown from a volcano. This glass is susceptible to alteration by the alkaline water trapped with it as the tuff bed is buried under additional sediments. Although a tuff bed may extend over a very large area, not all of it is necessarily altered to zeolite minerals -- the conditions for alteration must be just right. Conversely, if there are several tuff beds, as Denny (1965) implies is the case with his Tsc unit, then there are several chances that one or more of them have been altered to zeolites (Papke, 1972).

5. Mineral Economics

Most zeolites presently being used are synthetic minerals, but there are natural deposits of zeolites, and some of these are being developed and markets are being sought for them. Few details are known about the economics of zeolites, so this description of their mineral economics is necessarily generalized. The United States probably uses much less than 100,000 tons of zeolites annually. Japan, where natural zeolites are used as agricultural soil conditioners and in paper, probably uses appreciably more. United States use, mostly of synthetic zeolites, is largely as catalysts in the cracking of petroleum, as molecular sieves (in which application molecules of some compounds essentially become lost in the intricate crystal structure of the zeolite, while those of other compounds pass through), and as ion exchangers. The United States has large deposits of natural zeolites, sufficient to sustain large consumption. Some advocates of zeolites foresee that the present miniscule domestic production will increase to many thousands to tens of thousands of tons in the coming years, as large-scale applications are found for their unusual characteristics. There is no established price for zeolites.

Although the deposits in the Resting Spring GRA are 75 miles or more from the nearest rail point, the present and expectable price of zeolites is high enough that the long haul to market is not a deterrent.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

There are no known uranium or thorium deposits within or near the GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There are no known uranium or thorium prospects or occurrences within or near the GRA.

3. Mining Claims

Uranium and thorium claims and leases are not distinguishable in the area.

4. Mineral Deposit Types

The lack of known radioactive mineralization in the area precludes a discussion of deposit types.

5. Mineral Economics

Uranium and thorium would appear to be of little economic value within the GRA as there are no known deposits in the area.

Uranium in its enriched form is used primarily as fuel for nuclear reactors, with lesser amounts being used in the manufacture of atomic weapons and materials which are used for medical radiation treatments. Annual western world production of uranium concentrates totaled approximately 57,000 tons in 1981, and the United States was responsible for about 30 percent of this total, making the United States the largest single producer of uranium (American Bureau of Metal Statistics, 1982). The United States ranks second behind Australia in uranium resources based on a production cost of $25/pound or less. United States uranium demand is growing at a much slower rate than was forecast in the late 1970s, because the number of new reactors scheduled for construction has delcined sharply since the accident at the Three Mile Island Nuclear Plant in March, 1979. Current and future supplies were seen to exceed future demand by a significant margin and spot prices of uranium fell from $40/pound to $25/pound from January, 1980 to January, 1981 (Mining Journal, July 24, 1981). At present the outlook for the United States uranium industry is bleak. Low prices and overproduction in the industry have resulted in the closures of numerous uranium mines and mills and reduced production at properties which have remained in operation. The price of uranium at the end of 1982 was $19.75/pound of concentrate.

Oil and Gas Resources

1. Known Oil and Gas Deposits

There are no known oil and gas deposits in the GRA.

2. Known Prospects, Oil and Gas Occurrences and Petroliferous Areas

No oil seeps or shows in exploration wells are known to be present in the GRA or the immediate region.

3. Oil and Gas Leases

There are a few scattered leases, mostly in the valley areas, around the WSA.

4. Oil and Gas Deposits

Oil deposits that have been found and developed, and those that are being explored for in the Basin and Range to date, have been limited to the Upper Paleozoic section of the Miogeosyncline and the Tertiary section of the intermontane basins. The source rocks are assumed to be in Paleozoic horizons, such as the Mississippian Chainman Shale, and perhaps also the Tertiary section.

The reservoirs at the Trap Spring and Eagle Springs oil fields in Railroad Valley are teh Oligocene Garrett Ranch volcanics or equivalent, which produce from fracture porosity; or the Eocene Sheep Pass Formation, a freshwater limestone. Minor production has been recorded from the Ely(?) Formation of Pennyslvanian age at Eagle Springs. It may be that production also comes from other units in the Tertiary or Paleozoic sections in the Blackburn oil field in Pine Valley or the Currant and Bacon Flat oil fields in Railroad Valley.

5. Oil and Gas Economics

The low level of production from Nevada Basin and Range oil fields, which are remote from existing pipelines, existing refineries and consuming areas, necessitates the trucking of the crude oil to existing refineries in Utah, California and Nevada. Since the discovery of oil in Nevada in 1953, the level of production has fluctuated. Factors which have affected the production from individual wells are: reservoir and oil characteristics; Federal regulations; productivity; environmental constraints; willingness or ability of a refiner to take certain types of oil; and of course, the price to the producer, which is tied to regional, national and international prices.

Geothermal Resources

1. Known Geothermal Deposits

There are a number of thermal springs and wells which are believed to have the capacity and temperature to support low-temperature uses. Locality #1 on the Geothermal Occurrences and Land Classification Map is a narrow belt of these wells and springs which have temperatures ranging from 70° to 92°F (Garside and Schilling, 1979).

2. Known Prospects, Geothermal Occurrences, and Geothermal Areas

The more sparsely scattered thermal wells and springs are shown as wells. These may be occurrences or deposits, depending upon the temperature and flow capacity of each locality.

3. Geothermal Leases

There are no geothermal leases in the GRA or vicinity.

4. Geothermal Deposit Types

Geothermal resources are hot water and/or steam which occurs in subsurface reservoirs or at the surface as springs. The temperature of a resource may be about 70°F (or just above average ambient air temperature) to well above 400°F in the Basin and Range province.

The reservoirs may be individual faults, intricate fault-fracture systems, or rock units having intergranular permeability -- or a combination of these. Deep-seated normal faults are believed to be the main conduits for the thermal waters rising from thousands of feet below in the earth's crust.

The higher temperature and larger capacity resources in the Basin and Range are generally hydrothermal convective systems. The lower temperature reservoirs may be individual faults bearing thermal water or lower pressured, permeable rock units fed by faults or fault systems. Reservoirs are present from the surface to over 10,000 feet in depth.

5. Geothermal Economics

Geothermal resources are utilized in the form of hot water or steam normally captured by means of drilling wells to a depth of a few feet to over 10,000 feet in depth. The fluid temperature, sustained flow rate and water chemistry characteristics of a geothermal reservoir, as well as the end use, determine the depth to which it will be economically feasible to drill and develop each site.

Higher temperature resources (above 350°F) are currently being used to generate electrical power in Utah and California, and in a number of foreign countries. As fuel costs rise and technology improves, the lower temperature limit for power will decrease appreciably -- especially for remote sites.

All thermal waters can be beneficially used in some way, including fish farming (68°F), warm water for year around mining in cold climates (86°F), residential space heating (122°F), greenhouses by space heating (176°F), drying of vegetables (212°F), extraction of salts by evaporation and crystallization (266°F), and drying of diatomaceous earth (338°F). These are only a few examples.

Unlike most mineral commodities remoteness of resource location is not a drawback. Domestic and commercial use of natural thermal springs and shallow wells in the Basin and Range province is a historical fact for over 100 years.

Development and maintenance of a resource for beneficial use may mean no dollars or hundreds of millions of dollars, depending on the resource characteristics, the end use and the intensity or level of use.

D. OTHER GEOLOGICAL RESOURCES

No other geological resources are known in WSA NV 050-0460. Coal is not known in the GRA, and there is no known potential for coal.

E. STRATEGIC AND CRITICAL MINERALS AND METALS

A list of strategic and critical minerals and metals provided by the BLM was used as a guideline for the discussion of strategic and critical materials in this report.

The Stockpile Report to the Congress, October 1981-March 1982, states that the term "strategic and critical materials" refers to materials that would be needed to supply the industrial, military and essential civilian needs of the United States during a national emergency and are not found or produced in the United States in sufficient quantities to meet such need. The report does not define a distinction between strategic and critical minerals.

No strategic or critical minerals or metals are known in WSA NV 050-0460.

IV. LAND CLASSIFICATION FOR G-E-M RESOURCES

Cornwall (1972) and Streitz and Stinson (1974) provide good geologic maps of the GRA at 1:250,000 scale; we found no larger scale coverage. There is no information at all about alteration and metallic mineralization. There is fairly good data concerning nonmetallics -- zeolites, and oil and gas and geothermal resources. Overall, the quantity of geologic data available is fairly good, and the quality also fairly good -- the problem lies with the scale of the published maps and the implied scale at which the field work was done. The quantity and quality of information concerning metallic minerals is adequate, if one assumes that no information at all means there is nothing there to be informed about it. The quantity and quality of data on other mineral resources is adequate.

Land classification areas are numbered starting with the number 1 in each category of resources. Metallic mineral land classification areas have the prefix M, e.g. M1-4D. Uranium and thorium areas have the prefix U. Nonmetallic mineral areas have the prefix N. Oil and gas areas have the prefix OG. Geothermal areas have the prefix G. Sodium and potassium areas have the prefix S. The saleable resources are classified under the nonmetallic mineral resource section. Both the Classification Scheme, numbers 1 through 4, and the Level of Confidence Scheme, letters A, B, C, and D, as supplied by the BLM are included as attachments to this report. These schemes were used as strict guidelines in developing the mineral classification areas used in this report.

Land classifications have been made here only for the areas that encompass segments of the WSA. Where data outside a WSA has been used in establishing a classification area within a WSA, then at least a part of the surrounding area may also be included for clarification. The classified areas are shown on the 1:250,000 mylars or the prints of those that accompany each copy of this report.

In connection with nonmetallic mineral classification, it should be noted that in all instances areas mapped as alluvium are classified as having moderate favorability for sand and gravel, with moderate confidence, since alluvium is by definition sand and gravel. All areas mapped as principally limestone or dolomite have a similar classification since these rocks are usable for cement or lime production. All areas mapped as other rock, if they do not have specific reason for a different classification, are classified as having low favorability, with low confidence, for nonmetallic mineral potential, since any mineral material can at least be used in construction applications.

1. LOCATABLE RESOURCES

a. Metallic Minerals

WSA NV 050-0460

M1-2B. This classification area covers the entire WSA. Some of the Paleozoic rocks in it, specifically the Stirling quartzite and the Wood Canyon Formation, are known to be favorable for gold mineralization elsewhere in the region. It is because of this that the classification of low favorability is made, with a low level of confidence.

b. Uranium and Thorium

WSA NV 050-0460

U1-1A. This land classification covers most of the WSA. Paleozoic metasedimentary rocks crop out through most of the area. The area is not favorable for uranium or thorium concentration at a very low level of confidence because there are no apparent source rocks for these elements in the area.

U2-2B. This land classification includes the northwestern border of the WSA. The area is covered by Quaternary alluvium and Tertiary tuffaceous sediments. The tuffs are prospective source rocks for uranium and both the Quaternary and Tertiary sediments are potential uranium host rocks, for epigenetic sandstone-type uranium deposits.

The area has very low favorability for thorium, at a very low confidence level, due to the apparent lack of source rocks in the area.

c. Nonmetallic Minerals

WSA NV 050-0460

N1-2B. This classification area covers small parts of the northern edge of the WSA. In it are mapped (Cornwall, 1972) the Tertiary lake beds that a short distance farther north have been staked and mined by Anaconda for zeolites. The presence of the lake beds is certain, but it is not known whether zeolite beds are present.

N2-2B. This classification area covers the remainder of the WSA. The rocks in it are not known to have any nonmetallic mineral occurrences, but any mineral material may become an economically mineable nonmetallic mineral if a market can be found that makes use of the material's chemical or physical properties, or can be used in construction applications.

2. LEASABLE RESOURCES

a. Oil and Gas

WSA NV 050-0460

OG1-1D. Except for a thin veneer of Quaternary alluvium, the entire area is underlain by Precambrian and Cambrian rock units. There is no prospective petroleum source beds in the stratigraphic section. The WSA is not believed to be within the Overthrust Belt.

b. Geothermal

WSA 050-0460

G1-2A. Most, if not all, of the thermal waters are located in the Cenozoic valley fill. The main thermal locality (#1 on the Geothermal Occurrence and Land Classification Map) is a northwesterly-trending belt, parallel to the regional structure. A major fault passes directly through the thermal zone. The WSA is within two or three miles of the nearest thermal spring, and is on structural trend with the thermal belt.

c. Sodium and Potassium

S1-1D. This classification applies to the entire WSA. There is no indication of favorability for the accumulation of resources of sodium and potassium. No map is presented for sodium and potassium.

3. SALEABLE RESOURCES

Saleable resources have been considered under the heading Nonmetallic Minerals.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

No additional work is recommended for WSA NV 050-0460.

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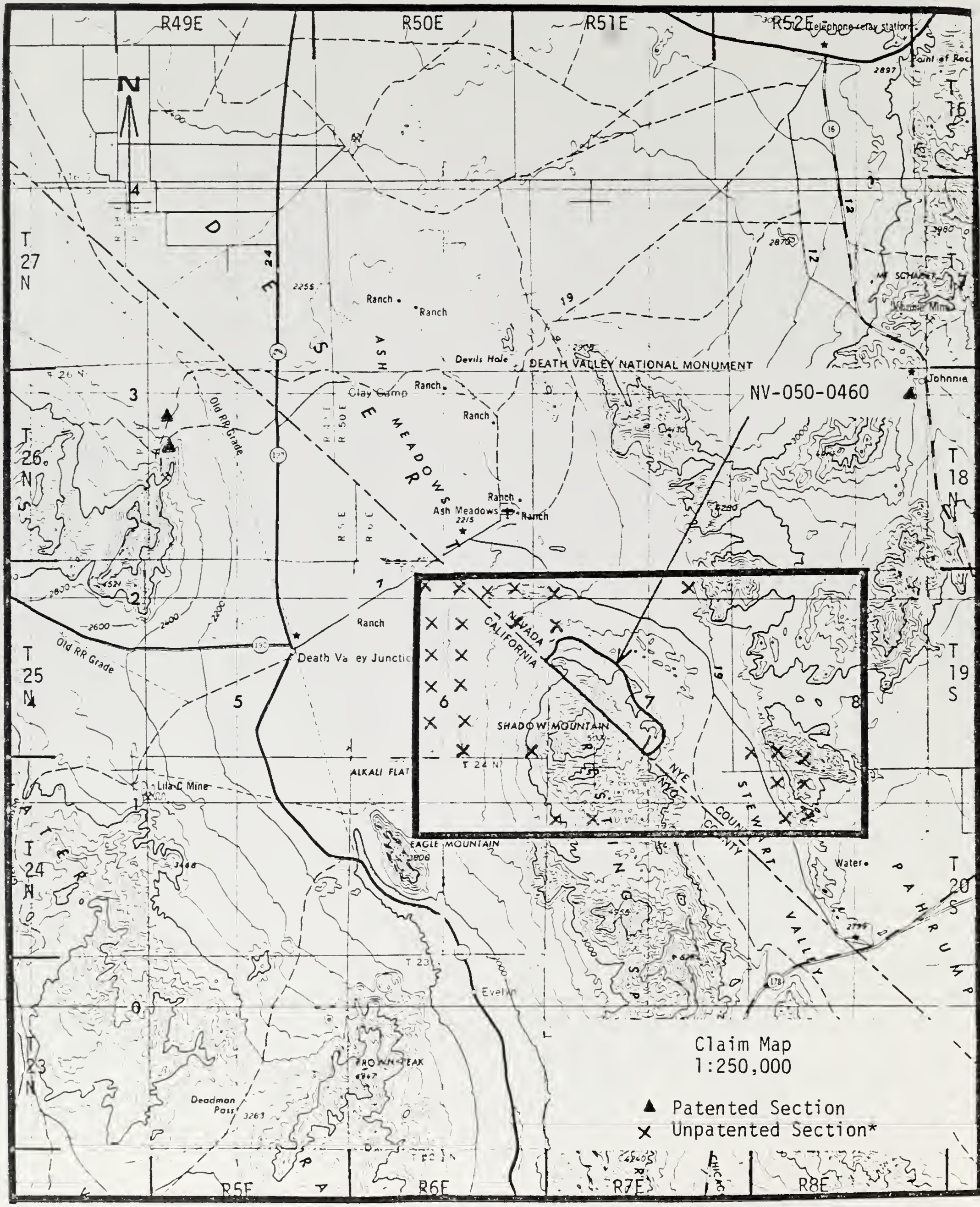
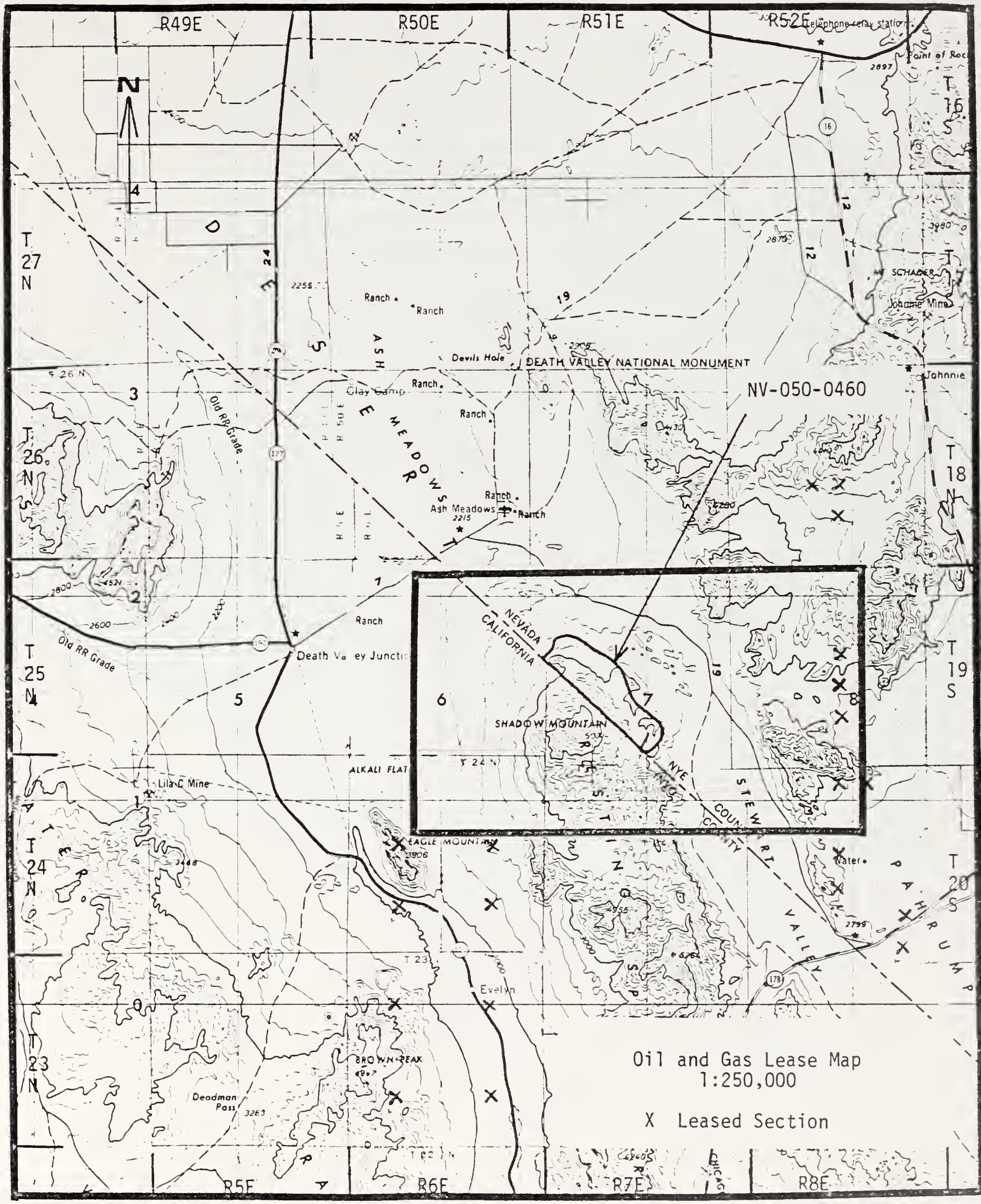


*X denote one or more claims per section

Resting Spring Range GRA NV-30



Oil and Gas Lease Map
1:250,000

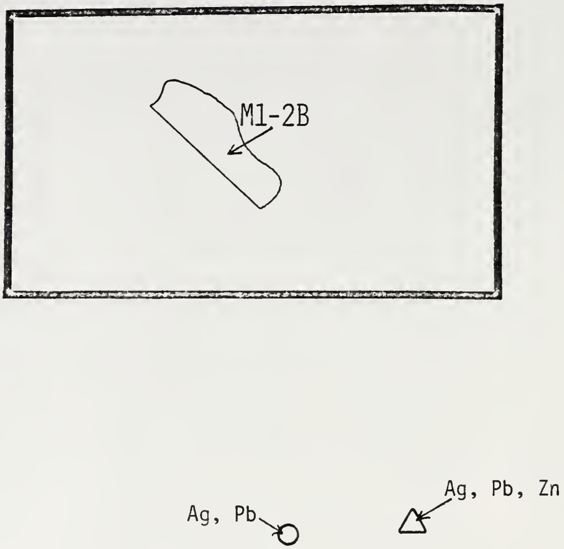
X Leased Section

EXPLANATION

△ Mine, commodity

○ Occurrence, commodity

——— WSA and Land Classification Boundary



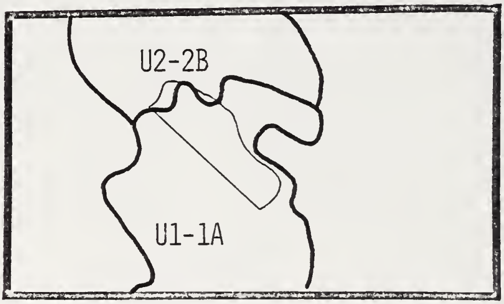
Land Classification - Mineral Occurrence Map/
Metallics

Resting Spring Range GRA NV-30
Scale 1:250,000

EXPLANATION

━ Land Classification Boundary

— WSA Boundary



Resting Spring Range GRA NV-30
Scale 1:250,000

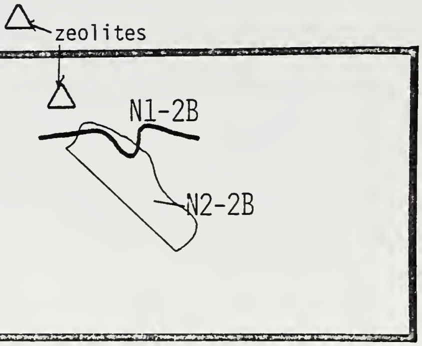
Land Classification - Mineral Occurrence Map/Uranium

EXPLANATION

△ Mine, commodity

▬ Land Classification Boundary

— WSA Boundary

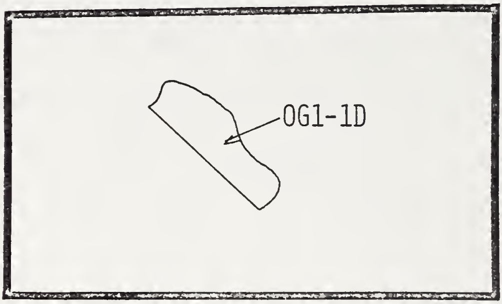


Land Classification - Mineral Occurrence Map/
Nonmetallics

Resting Spring Range GRA NV-30
Scale 1:250,000

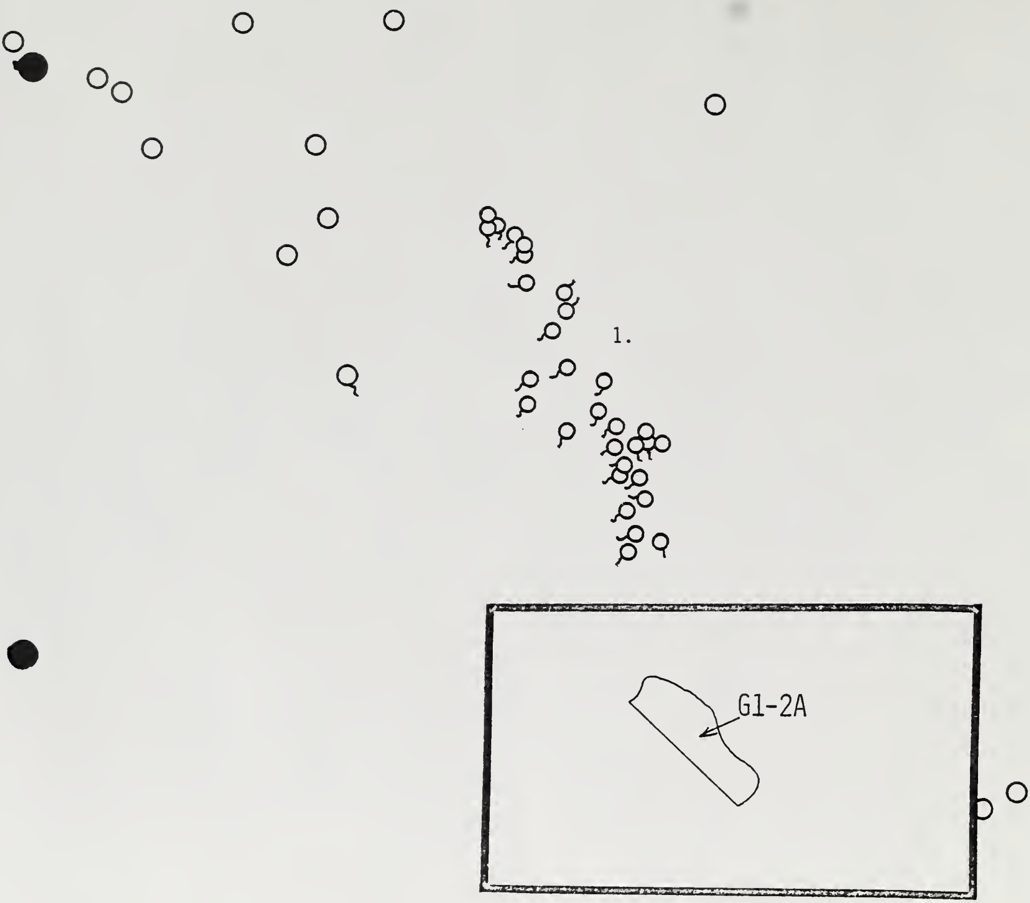
EXPLANATION

——— WSA and Land Classification Boundary



Resting Spring Range GRA NV-30
Scale 1:250,000

Land Classification - Mineral Occurrence Map/Oil and Gas



EXPLANATION

○ Thermal Well

⚲ Thermal Spring

— WSA and Land Classification Boundary

1. Reference location, (see text)

Resting Spring Range GRA NV-30
Scale 1:250,000

Land Classification - Mineral Occurrence Map/Geothermal

LEVEL OF CONFIDENCE SCHEME

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT TO REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

MAJOR STRATIGRAPHIC AND TIME DIVISIONS IN USE BY THE U.S. GEOLOGICAL SURVEY

Erathem or Era		System or Period	Series or Epoch	Estimated ages of time boundaries in millions of years
Cenozoic		Quaternary	Holocene	
			Pleistocene	2-3 [1]
		Tertiary	Pliocene	12 [1]
			Miocene	26 [2]
			Oligocene	37-38
			Eocene	53-54
			Paleocene	65
Mesozoic		Cretaceous [4]	Upper (Late) Lower (Early)	136
		Jurassic	Upper (Late) Middle (Middle) Lower (Early)	190-195
		Triassic	Upper (Late) Middle (Middle) Lower (Early)	225
Paleozoic		Permian [4]	Upper (Late) Lower (Early)	280
	Carboniferous Systems	Pennsylvanian [4]	Upper (Late) Middle (Middle) Lower (Early)	
		Mississippian [4]	Upper (Late) Lower (Early)	345
		Devonian	Upper (Late) Middle (Middle) Lower (Early)	395
		Silurian [4]	Upper (Late) Middle (Middle) Lower (Early)	430-440
		Ordovician [4]	Upper (Late) Middle (Middle) Lower (Early)	500
		Cambrian [4]	Upper (Late) Middle (Middle) Lower (Early)	570
Precambrian [4]			Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	3,600+ [3]

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[1] Holmes, Arthur, 1965, Principles of physical geology: 2d ed., New York, Ronald Press, p. 360-361, for the Pleistocene and Pliocene, and Obradovich, J. D., 1965, Age of marine Pleistocene of California: Am. Assoc. Petroleum Geologists, v. 49, no. 7, p. 1087, for the Pleistocene of southern California.

[2] Geological Society of London, 1964, The Phanerozoic time-scale; a symposium: Geol. Soc. London, Quart. Jour., v. 120, supp., p. 260-262, for the Miocene through the Cambrian.

[3] Stern, T. W., written commun., 1968, for the Precambrian.

[4] Includes provincial series accepted for use in U.S. Geological Survey reports.

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

GEOLOGIC NAMES COMMITTEE, 1970